"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

Autumn 2008
Issue 61

Contents

The Walford Electronics website is also at www.walfordelectronics.co.uk

Editorial

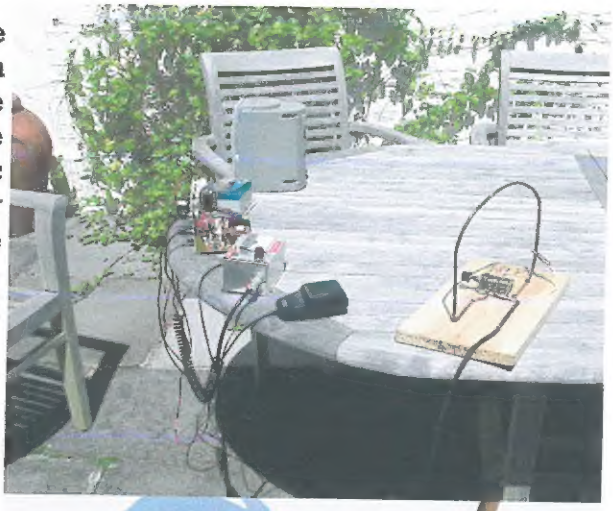
How time flies - here we are at the start of the 16th year for Construction Club members and I ponder what to put in this time! I could drone on about this lovely Summer that we are enjoying on the farm; or I could be a real boring old whatnot and decry the trends in modern electronics where everything has to be 'digital' with embedded microprocessors. Instead I wonder how (when somewhat younger) I ever managed to do anything out of normal working hours like decorating, gardening, rewiring the house, and occasionally play with a radio! After a day's work, a quick check of the electronic mail, some food and there is now not sufficient time left for radio! I have a list of potential new projects or upgrades that just does not get any shorter despite my good intentions! I swear that Einstein should be doing an experiment on time running faster nowadays. I fear there is a more mundane explanation which I don't want to know! Inevitably social and community activities take up an increasing amount of time because one's circle of friends grows with age - especially if one has lived in the same place for a long time. (Next year it will be six decades since I first came to this house!) The place still has surprises up its sleeve though - we have had a damp problem in a bedroom wall (for many years) that I am now told is probably condensation in a concealed old chimney sealed top and bottom. I have found its bottom but not yet the top - I wish electronics could help with this but not enough time..... Tim

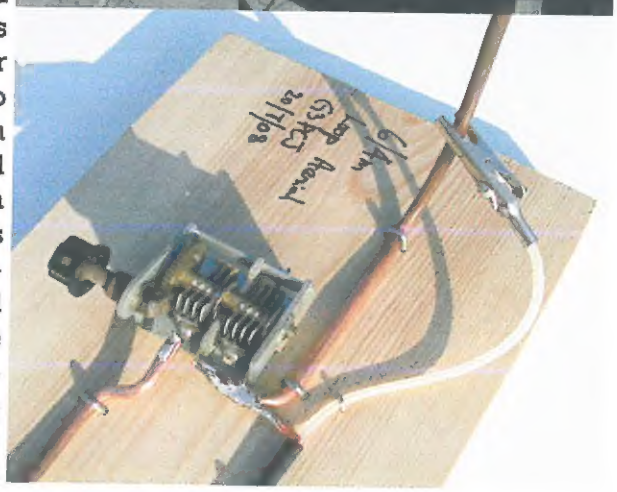
Kit Developments

I am pleased to report that the Audio Extra and Notch filter kits have just been proven by Richard Booth and Andy Howgate and will be available shortly - see later. Although these have been designed primarily for the Minster they can be used with other rigs as well. The Minster is not yet ready for release as its performance on 10 and 15m is not really good enough. I have been troubled by a variable gain amplifier, which is used on reception and transmission, that was more like an attenuator on 10m!! Meanwhile here are some handy aerial tools!! Tim

Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics– is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

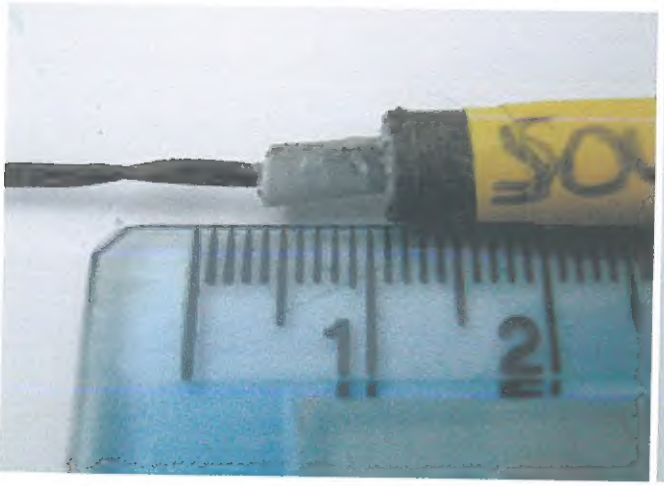
Chirnside, 6m and a conundrum!

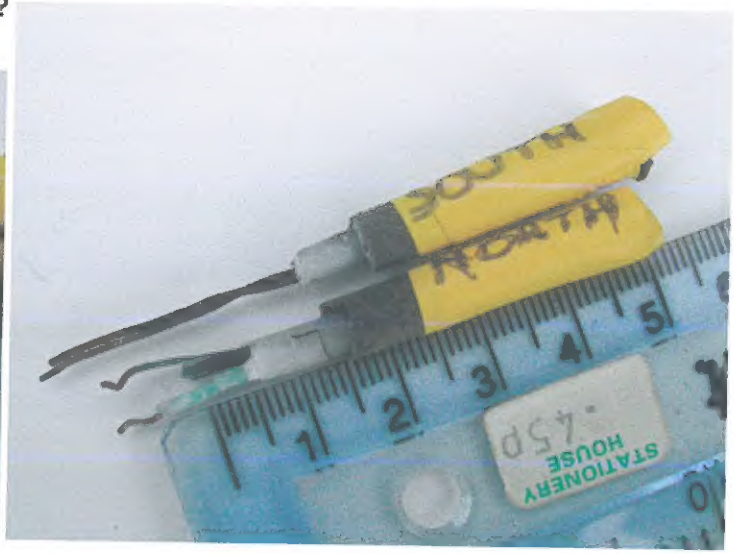




Since I wrote last time about my friends wartime bunker, I have been able to get his WS17 set working on battery supplies; I used a NiCd powering switch mode regulators to produce 2.5v (dropped by a diode) for the 2 volt heater, and a 9v regulator driving a 50 Hz static inverter feeding a 6-0-6v to 115v mains transformer for the 120v HT. These modern parts conveniently fit inside the original battery compartments of the 17 set. Not having any other 6m gear (apart from my Heathkit GDO) I had to test the 17 against my prototype Chirnside TCVR. At least I knew the Chirnside's transmit frequency as it is rock bound, multiplied up from 10.24 MHz! Both seemed to work alright on dummy loads so I then needed two 'aerials' which I could eventually take to his house and at least have a QSO across his garden! The 17 set was often used with vertical aluminium rod dipoles, with or without a reflector, but even at 6m a half wave is not too good for fitting in a small car! I needed something much smaller or collapsible like a vertical wire half wave, fed at its centre by coax threaded up inside the screen of a larger coax acting as the bottom half of the dipole. This could then be coiled up for transport. This was not difficult to make and is easily installed in a tree with the aid of a thrown weight and string. Strictly this ought to have a choke balun fitted in the feed coax just below the bottom of the lower radiator, but for informal trials where the radiation pattern is not too important, I skipped that. For the Chirnside's aerial I used a small loop with gamma matching - they both worked well!

However, we have so far been unable to properly explain the aerial and feeder arrangements that were installed at my friends house during the war. One dipole aerial definitely used a plain twin low impedance feeder without any overall screen - this is the Northern specimen below. The other aerial appears to have been 'fed' by a single conductor (without screen) prior to going up a tree to its radiating elements whose details are unknown - the southern cable. Both cables were buried directly in the earth for a significant distances. Their construction is similar (and definitely for RF) except for one being twin and the other a single. Both have a cloudy plastic (? polythene) main insulation within an overall plastic outer. The twin feeder is well explained but the other single RF wire is a mystery. No evidence has yet been found for a second similar cable alongside it either. Its unlikely to be a Windom type feed with so much of it below ground, nor a counterpoise at 50 MHz - so what was its purpose? Any suggestions are very welcome! Tim

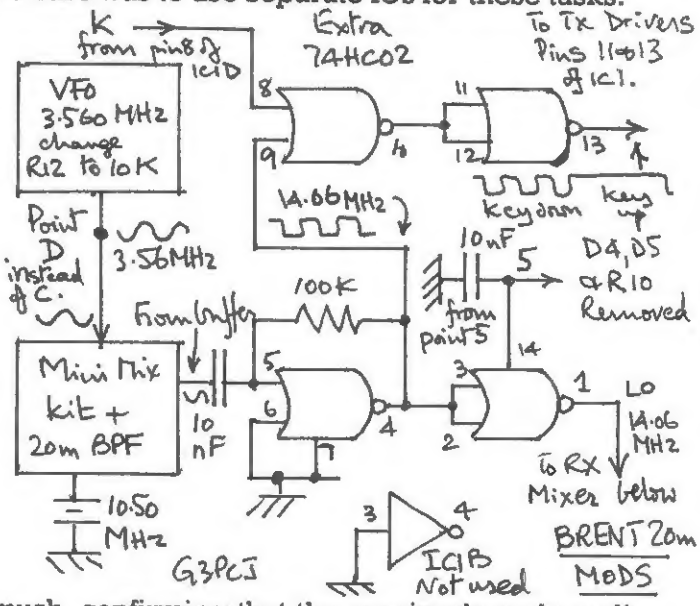




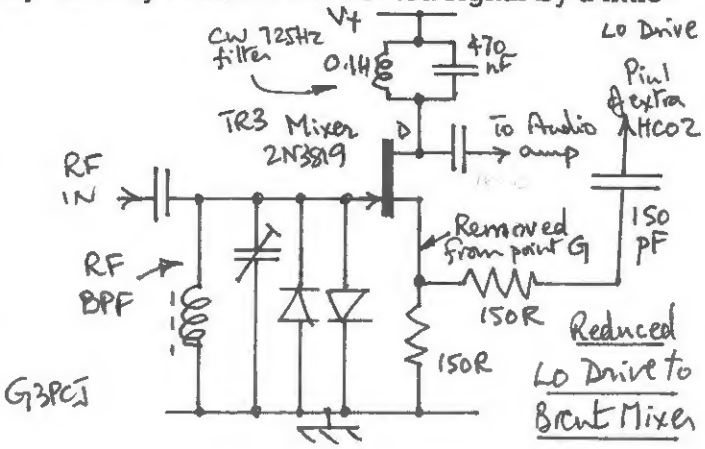
The Brent on 20m

Recently a customer asked me to investigate his Brent, fitted with a Mini mixer for 20m. His main complaint was 'too many birdies'! I have to admit that there were rather too many. He had also had difficulty with severe audio instability which had been cured by adding 1000 uF across the incoming supply. This was I think due to some quirk in his power supply, as I was not able to replicate that problem. There were other minor snags such as an intermittent short between the Poly-Varicon bolt heads and the ground plane which were easily cured by a little insulating tape! But the birdies had me foxed for a while. The basic frequency scheme is to mix the normal 80m VFO, which has a square wave LO (using a digital gate and a ceramic resonator), with a 10.5 MHz crystal. The LO mixer is a SA602 and this feeds a double tuned LO filter tuned to 14.05 MHz, which is then squared up for the RX mixer by further gates. With such a simple scheme there is inevitably a strong birdie on the band edge at 14.0 where the VFO is on 3.50 MHz, and its fourth harmonic comes through strongly into the RX front end. However there were many high order (with fast tuning rate), and very much weaker, birdies near to 14 MHz. After trials with an external VFO I concluded these had to be leakage (or capacitive coupling) from the square wave VFO into the mixer driver gate within their single integrated circuit. The cure was to use separate ICs for these tasks.

Adding an extra digital IC to cure the birdies also allows one of the other known design compromises of the Brent to be removed; that is the rather crude form of keying the transmitted signal using a diode gate with a pull down resistor. To obtain the necessary fall time at 14 MHz requires an uncomfortably small pull down resistor, which often leads to an un-symmetrical drive to the output stage and less RF output. The solution is to use an extra 2 input NOR gate without the diodes and pull down resistor, and use the other NOR gates for the birdie solution. This is shown right.

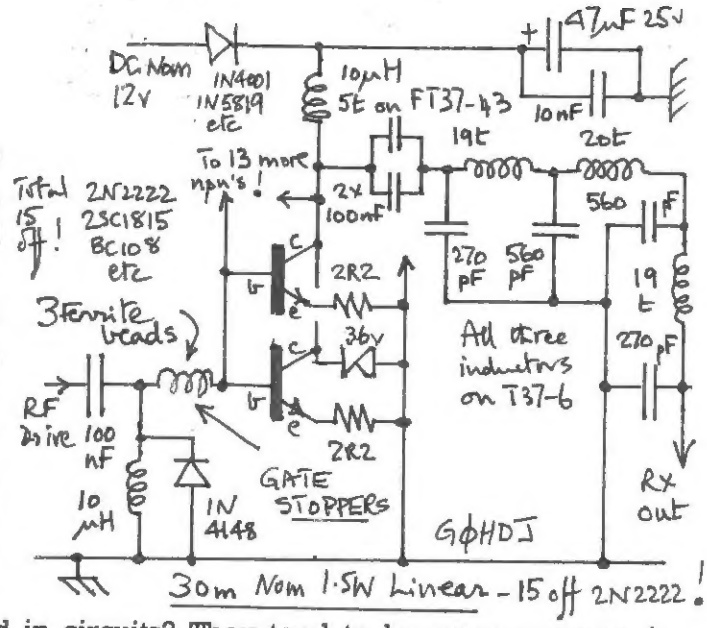


Having just acquired a new set of phones, to replace my tired 'Walkman' style ones, I was a bit disappointed with the level of audio hash or noise coming from this RX. Removing the LO drive to the receiver's mixer stopped most of this mush, confirming that the receiver's early audio stage was not to blame! So why was the mixer noisy? A fair bit of web trawling didn't produce an answer but an old ARRL handbook suggested that driving the JFET into the pinch-off region is unwise. I had specifically aimed to do this by connecting the mixer FET source direct to the output of the LO driving gate, with its 5v LO signal. I was confident that using a square drive was not the problem as all the potential harmonic products would be well above the operating band. A little experimentation with reduced injection levels into the mixer FET source soon showed that the audio hash was hugely dependent on LO level, but that conversion gain was far less critical. Halving the LO drive signal chopped most of the mush away but only reduced the wanted signal by a little - leading to a significant improvement in signal to noise ratio and plenty of off-air signals!.



I would expect this mush improvement to apply to all Brents, whether for 80m or higher bands. It can be easily altered by adding the two resistors and capacitor as 'free-standing' items as shown right. The first modification mentioned above, to cure birdie problems and improve the TX keying, is not necessary for 80m Brents. If anybody needs these extra parts, please let me know. Tim
G3PCJ

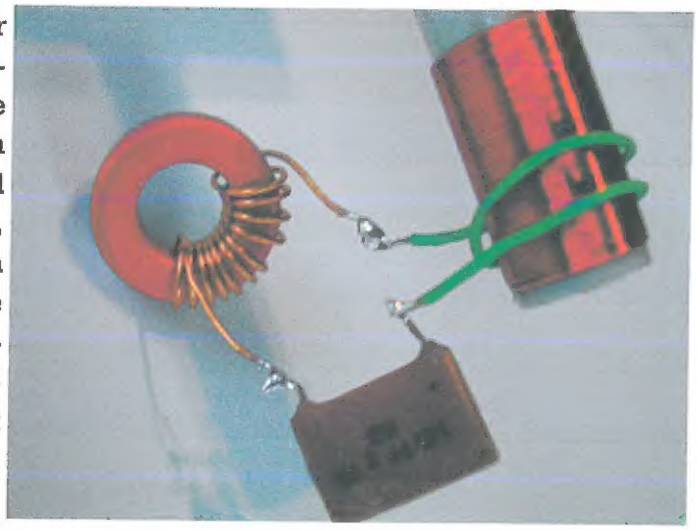
Gate stoppers and ferrites



Craig Douglas sent me the circuit right asking for advice as to why he could not obtain the expected output from the version that he had built. I was a bit busy at the time and as it appeared to be a perfectly good circuit, I delayed my response pending further thought. I am pleased to report that Craig solved it before I did! He had used some ferrite beads for the gate stoppers and in desperation had tried it without these in the drive to the output devices - lo and behold it burst into life as expected! Clearly the 'gate stoppers' were stopping the wanted signal!

So why are gate stoppers often included in circuits? They tend to be more common in power FET circuits but nearly all common drain or common collector (unity voltage gain buffers) circuits can lead to VHF or higher oscillation, particularly when the device is feeding a high capacitance load. Years ago I had this problem with the audio CW filter in the Midney RX! The clue was that all the birdies (oscillation) stopped when I connected a scope probe or even put a finger on the filter FET - in that case the unwanted oscillation was over 50 MHz! The inclusion of a small amount of attenuation at VHF is often sufficient to reduce the VHF gain below that required for oscillation. Often an inductor is used, or ferrite beads, or a few turns of wire on a low value resistor so that the impedance increases with frequency; so giving a higher impedance/reduced gain at VHF while still presenting a negligible attenuation to the wanted signal at HF or lower. As the Midney was an audio circuit, where the gate impedance is all capacitance, it was easily cured by adding 1K (for commonality with other resistors) in series with the buffer's gate - its quite likely that just 10R would have been sufficient!

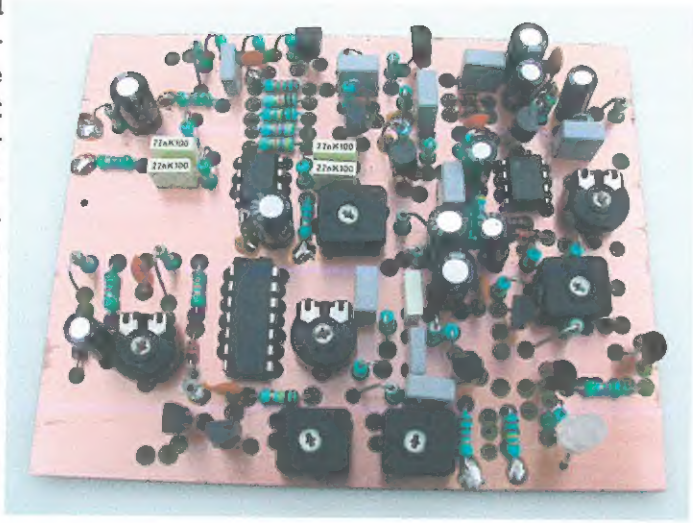
The lesson of Craig's experience is that the impedance at the operating frequency of his ferrite beads was far too high, but why? Obviously the inductance was far higher than it should have been, given that he had only threaded them on without multiple turns; this suggested that the ferrite beads had a very high inductance per 'turn'. This is often the case for ferrite materials which are intended for low frequency or power supply work, and although I don't know it, I suspect these beads had been salvaged from the hash filter of a switched mode mains PSU. Ferrite materials are usually a dull black and notoriously difficult to identify by visual inspection (unlike powdered iron toroids which are coloured); the real answer has to be to measure the inductance of a turn or two and see if its suitable for the intended circuit.



The easiest way to do this is with a gate or grid dip oscillator. I don't have a picture of a ferrite bead being investigated but the technique shown right can be used with any inductor. In this case, the toroid has such a low external field that it will not satisfactorily couple to a GDO, hence the two turns around the GDO coil. Try a few different value capacitors in series with the ferrite bead inductor and GDO turns and be prepared for resonant frequencies that are somewhat lower than normal. Knowing the resonant frequency and the value of the capacitor will let you calculate the inductor value. G3PCJ

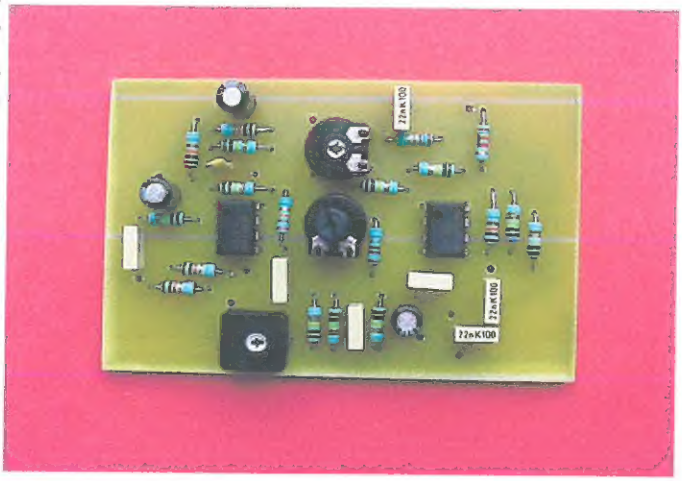
The new Audio kits

Audio Extras This kit provides CW and AGC facilities for a phone TCVR; it has been designed for the Minster but also suits other phone TCVRs. For reception, there is a choice of straight through, an intermediate LPF (1.2 KHz) or narrow audio filtering; the narrow audio filter has an **adjustable bandwidth** of about 40 to 300 Hz with a centre frequency of nominally 725 Hz. The selected filter feeds the AGC system (either direct or via the Notch filter kit) and provides a constant output of 250 mV p-p, for audio input signals that are above 15 mV p-p. There is a choice of Long or Medium AGC time constants, or off altogether. The AGC control voltage also drives the green section of a bi-colour LED whose intensity alters with received signal level.



For CW transmission, a keyed audio tone is injected into the phone transmitter's speech amplifier to produce the desired carrier, with adjustable frequency and level presets for TX and RX. The TR control system provides semi-break in operation with another preset to set the delay time. The red section of the LED is driven by the rig's antenna matching bridge circuits to give an indication of RF power output. The LED circuits can also drive a conventional meter scaled for 10v FSD. The PCB is double sided needing a 9 – 22 volt supply. Apart from the optional bandwidth pot and meter (see below), the other front panel items are the key socket, filter toggle switch, AGC toggle switch, and the LED. The Audio extras kit costs £28.

Notch Filter This kit provides a **variable frequency** Notch or Peak filter to clean up receiver audio. Although designed for the Minster, it can be used with most receivers. The filter can be switched out when not required. It has an adjustable frequency bandpass filter with an additional op-amp to provide the peak or notch facility. The frequency of the Notch/Peak is altered with a single variable resistor (unlike most designs) and can be changed to a front panel pot. The filter has three tuning ranges; the middle one covers the normal range of CW beat notes, with additional high and low ranges for the rest of the audio band. The bandwidth of the filter can also be adjusted, but is not usually altered after setting up.



The kit is normally connected immediately before the rig's main audio gain control stage – either automatic or manual. It can also be used as a separate receiving accessory outboard of an existing rig to drive medium Z phones. Apart from the optional frequency control, the other front panel items are the frequency range and notch/peak toggle switches. The PCB is single sided (50 x 80 mm) and needs a 9 to 22 volt supply. Cost is £18.

Meter and pots A horizontal edge meter (for signal strength and RF Pout), with two pots for front panel variable frequency and variable bandwidth controls are available for £9.

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It is probable that the next issue of Hot Iron will be delayed till about mid December as I have some important farming business that will take me away for most of November. Please bear with me; if you are able to send me any contributions so that I don't have to write quite so much, it will hasten its production! As ever I shall be delighted to have any articles or suggested topics etc, up to about a page or thereabouts. In the meantime my apologies in advance. Tim G3PCJ

Building and de-bugging an 'old' project by Steve Hartley, G0FUW

Way back in the mists of time, well twenty four years ago to be precise, I saw a project in RadCom and thought 'one day I will build that'. The project was the G2DXK multi-band SSB/CW transceiver and I was but a young whipper-snapper with a fresh RAE pass slip and a VHF call. The project ran over several months and I kept the articles ready for the day when I had the time and money to make a start.

I cannot remember exactly when I started building but I can report that I never got very far, even in several bursts of activity. However, earlier this year, realising that the project was approaching its silver anniversary, I decided that it was about time I knuckled down to getting the 'DXK on the air.

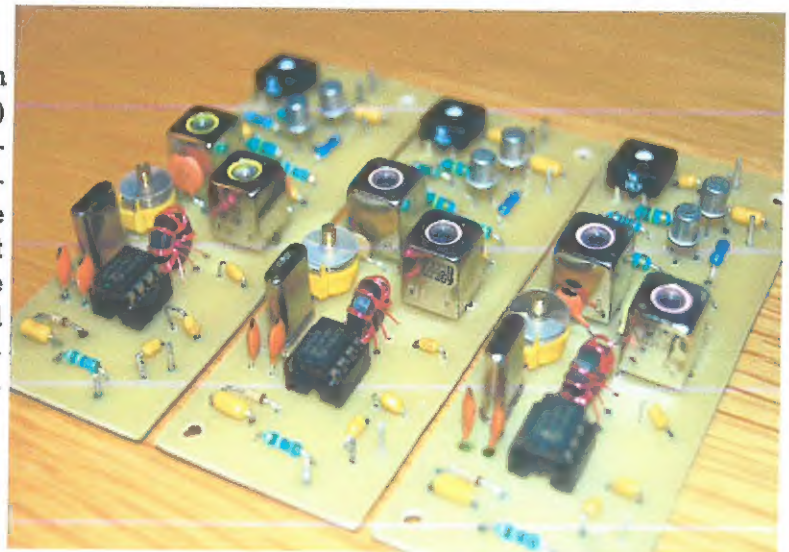
Co-incidentally, Richard Witney G4ICP, posted a noted on the G-QRP reflector to say he was in a similar position and we have been comparing notes and had a couple of meetings since then.

Some projects go together at the first attempt, all very pleasing, especially for the designer. Others have you delving into textbooks and trying all kinds of modifications and fixes to get them going, much more frustrating but a great source of 'self-development'. My 'DXK belongs to the latter - I have even learned how to use the mighty fine LTSpice to try to understand what is going on with some of the circuits.

In brief, here are some of the 'highlights'. First off the LM380 audio amp was getting very hot and making some horrible noises. Tim pointed me in the right direction by suggesting a 100uF cap across the DC input. The original design had one, but not on the AF board, hence my problem in testing the amp on its own!

Next the VFO refused to oscillate. I had never built a Vackar circuit before and I did not realise how critical the coil was. Richard Booth, G0TTL, came to the rescue with a recycled coil former and a very stable oscillator was had. Then I found that the VFO crystal mixer converter boards were producing some odd frequencies that were definitely not the sum, or the difference. Despite some recommended fixes with added feedback in the buffer amps the spurious emissions remained; I decided a different circuit was the answer. Several SPRAT circuits were researched, band pass filters designed using the software that came with 'Experimental Methods in RF Design', and a prototype board tested for 24MHz. This turned out to be much cleaner and controllable. Phew!

The latest set back was to find that the receiver was as deaf as a post with the BPF feeding straight into an SBL-1 mixer. I am now in the throws of redesigning the IF and maybe even adding some pre and post crystal filter amplification...



I am determined to complete the radio in time for the silver anniversary (1 May 09) and whilst the G2DXK transceiver architecture may be intact, the individual circuit building blocks will far from the original design. That said, I am sure that Lorin Knight, G2DXK (SK), would have been thrilled to know that he had spurred at least one amateur to expand his knowledge and skills in the home brew department.

(This reminds me of my tobacco tin project! Tim)

Whatever happened to the Woodpecker? - Part 2 by Richard Booth, G0TTL

Twenty years ago, the woodpecker made its last transmission and short wave radio enthusiasts could once again enjoy a little peace and quiet on the bands. Unfortunately that was to be short lived due to the advent of cheap domestic electronics products, with their noisy power supplies and poor RF screening. In 2008 the woodpecker would seem quite a minor irritation compared with the modern menaces like mains cable computer networking devices and equally a good number of plasma televisions. Rather than being several thousand miles away in the Soviet Union they are literally next door, and telling your neighbours will most likely generate the same response as Leonid Brezhnev gave in the late 1970's - "It's nothing to do with us" or words to that effect. Yes the USSR never actually admitted to generating that colossal carrier or made any effort to explain what it was.

Of course now we know the sole purpose of DUGA-3 was a brute force, over the horizon radar that needed a nuclear power plant as a battery and several ships worth of steel airborne as an antenna. However during the cold war years many theories existed as to what the real purpose of this strange radio signal was. I would take many if not all of them with a wry smile and large pinch of imagination! Outside official intelligence reports the most common idea was that the woodpecker was some kind of subversive scalar electromagnetic weapon, based loosely on the experiments of Nicola Tesla in the 1890's. Apparently the woodpecker carrier could be modulated at 10Hz or thereabouts and given its huge signal levels at the target areas, the ELF modulation phase locked into the radar transmission would affect our brain waves which naturally occur near this frequency. Supposedly causing psychological and physical disabilities - some go as far as to say death. Stories of this alleged property gave DUGA-3 a new identity in the Ukraine, namely the Brain Scorcher!

The weather. Yes the woodpecker could apparently interfere with that too by altering the jet streams! There are physics defying conspiracy theories by the bucket full on this topic, the main gist being that an extremely high power radio transmission, again using low frequency modulation beamed along the earth's magnetic field would in theory cause the charged electrons in the radiation belts to become excited. In effect generating artificial Aurora Borealis! Working rather like a microwave oven the kinetic energy build up in the excited electrons would increase their temperature significantly having the result of introducing new stratospheric winds and thus creating new high and low pressure weather cells. By using multiple transmitters these new artificial weather patterns could be steered to its destination and then wind or rain dumped on target. I for one do not believe a word of it.

If you could get even less plausible, the woodpecker was blamed by the tinfoil hat brigade for all kinds of other incidents, including various structural failures. Apparently it caused no end of bridges to collapse through induced metal fatigue. The same bunch suggested DUGA-3 shot down the Space Shuttle Challenger by swamping it with RF and a number of other military and civil aircraft were lost whist the Soviets practiced shooting their EM weapon. Honest!

The Amateur strikes back

It would seem at the time other than causing general annoyance to users of shortwave radio which included long haul commercial airlines, broadcasters and the military the only people to actually have a go at fighting the woodpecker were disgruntled radio amateurs. Governments made official complaints but this made little difference, and there would appear to have been little if any interest in the USA or NATO in developing an official electronic counter measure to defeat the system. So it was left to a bunch of amateurs to try their hand at making a bit of deliberate interference.

Radar which ever way you look at it is a system that generates an RF pulse and then listens out for reflected energy. If you could generate your own pulse at the correct time and as such fill in the gaps with a fake echo you might just be able to confuse the system. This is exactly what happened. The Russian Woodpecker Hunting Club was formed in the USA and resources gathered together to track the common frequencies of operation. When woody strayed into an amateur band they would get together and engage in a bit of electronic warfare. Despite using simple antennas and low power (compared to the MW coming out of the Chernobyl installation) the amateurs had some success. Maybe this was due in part to the massive receive array antenna set up as part of the DUGA-3 system. ..... *Continued next page with hunting club poster!!*

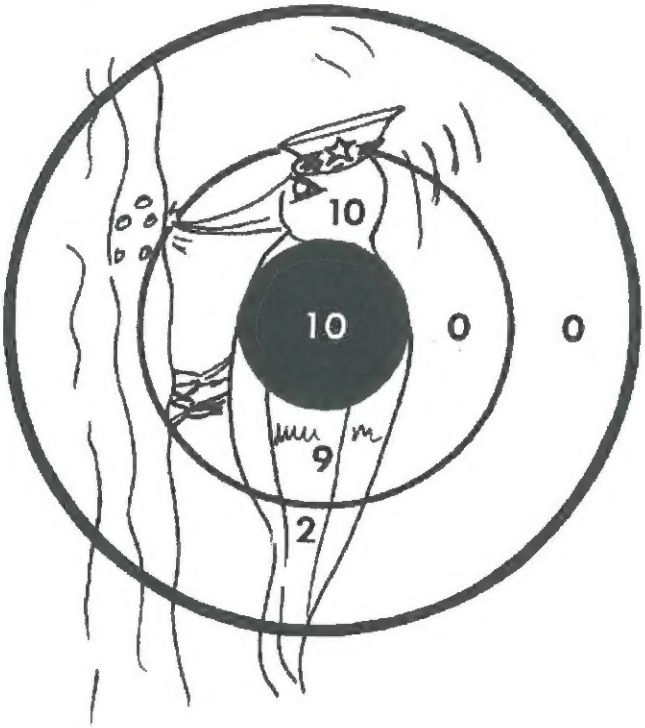
Woodpecker Pt 2 continued

Chasing the signal up and down the bands, sending fake echo CW bursts back to the USSR the most difficult problem to overcome was getting the critical timing right. Practice was the key quite literally; there were more than enough opportunities. However it worked in a crude small man against the might of the Soviet military way and sometimes it almost appeared that the woodpecker operators gave up and switched off for a break. Maybe the radar personnel thought the ionosphere conditions were just too unstable or more likely they threw the switch due to sheer frustration. Whatever happened though, the Soviet electricity meter would soon be busy again and the tock tock tock would return.

OFFICIAL PRACTICE TARGET

RUSSIAN WOODPECKER HUNTING CLUB

FOR TREATMENT OF RUSSIAN WOODPECKERPHOBIA USE AS: HAM SHACK DART BOARD; PISTOL RIFLE, SHOTGUN, MACHINEGUN, OR CANNON TARGET, ETC. RULES: NONE - OPEN SEASON. SUGGESTED RANGE: POINT BLANK. SCORING: ONLY THE DIRECT HITS COUNT; HEAD-SHOTS WITH ARMOR-PIERCING AMMO COUNT 20 POINTS. TARGET DISPOSAL: PLEASE DON'T LITTER - PROTEST THE GLOBAL DISRUPTION OF COMMUNICATIONS BY SENDING YOUR BEST TARGET TO: LEONID BREZHNEV, BOX 88, MOSCOW, USSR, OR ANY SOVIET EMBASSY



The Fifth Somerset Supper!

Next year the 25th Yeovil QRP Convention takes place on Sunday April 26th 2009. As usual I plan to hold a **Somerset Supper** the evening before on April 25th. I have in mind a slightly less formal style buffet supper to give people a better chance to mingle and discuss the exhibits. The previous venue is no longer available and as there is nothing else suitable in Sherborne, I plan to hold it at Lower Farm, Kingweston, near Somerton. My friends Jane and David Sedgman, who farm there, have a suitable meeting room (actually the old Court house); Jane also does B and B/catering for a limited number of guests. They are 'four star' members of Farmstay UK and will do us proud! David is also a very keen model railway enthusiast who might be persuaded to demonstrate his huge layout which adjoins the Court room. I am delighted to confirm that our guest of honour and judge for our informal radio construction show, will be Rev George Dobbs G3RJV - very well known as the Editor of the Journal of the QRP Club - SPRAT.

Make a note in your diaries now, and let me know if you are interested as places will be limited - the Sedgeman's website can be seen at lowerfarm.net If you wish to stay overnight with them please contact them direct. I hope you all have new projects to exhibit! Tim